SEP 8 1941

Gas Journal

LIGHT - HEAT - POWER - BY-PRODUCTS

Vol. 235. 93rd Year. LONDON, AUGUST 6, 1941. Registered as a Newspaper No. 4081. Price 1/-

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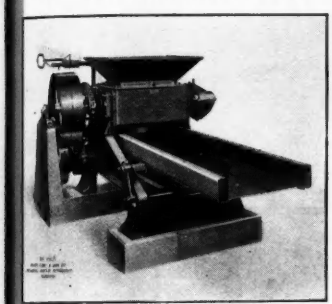
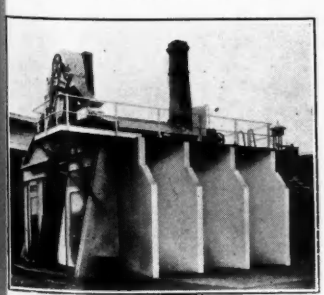
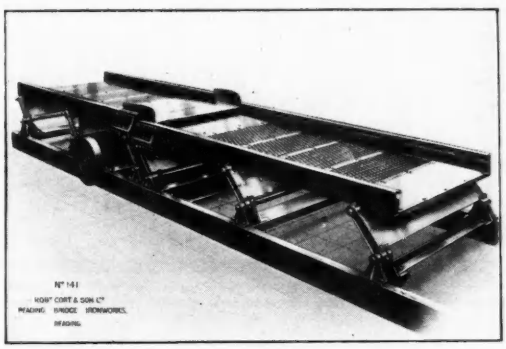


COKE CUTTING MACHINE WITH RECIPROCATING SCREEN

COKE CUTTING MACHINE SCREENING AND BAGGING UNIT



SUDBURY, SUFFOLK, 5 TONS PER HOUR



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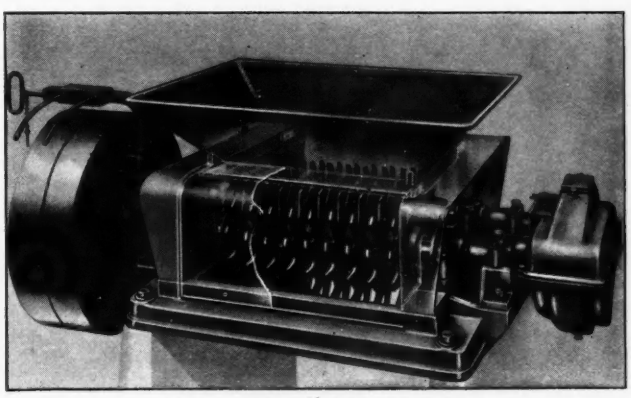
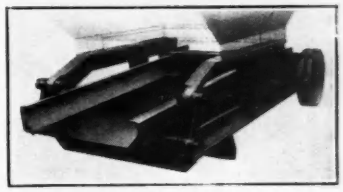
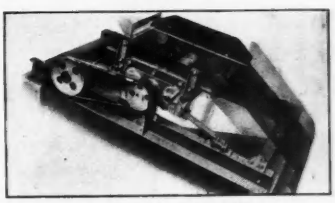


No. 18. COKE CUTTING MACHINE

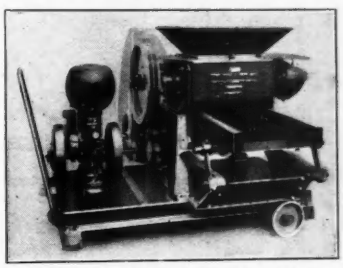
The above illustrates our latest development of *The* Coke Cutting (or Sizing) Machine—the "Heart" of all Coke Fuel Preparation Plant.



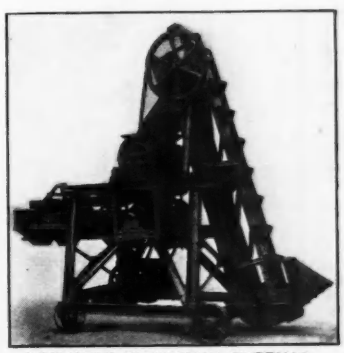
RECIPROCATING DEBREEZING SCREEN



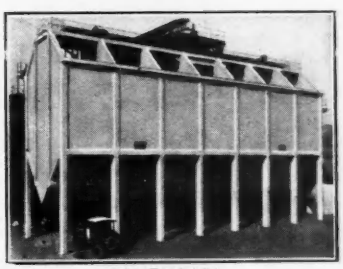
VIBRATORY SCREEN



PORTABLE COKE CUTTING AND SCREENING UNIT



PORTABLE ELEVATING CUTTING AND SCREENING UNIT



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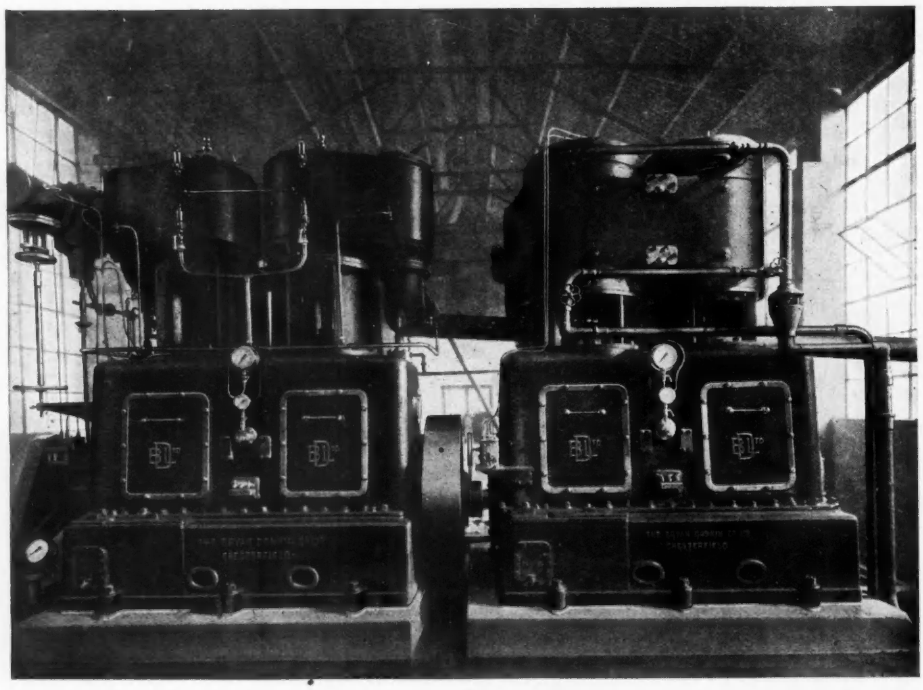

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Forced Lubrication

The Compressor illustrated is a two crank, single stage machine driven by a Compound Steam Engine. Capacity—200,000 cubic feet per hour against 25 lb. pressure with 120 lb. steam pressure and running at 325 r.p.m.

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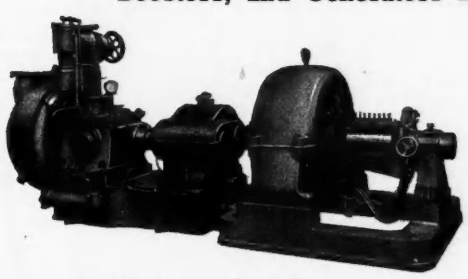

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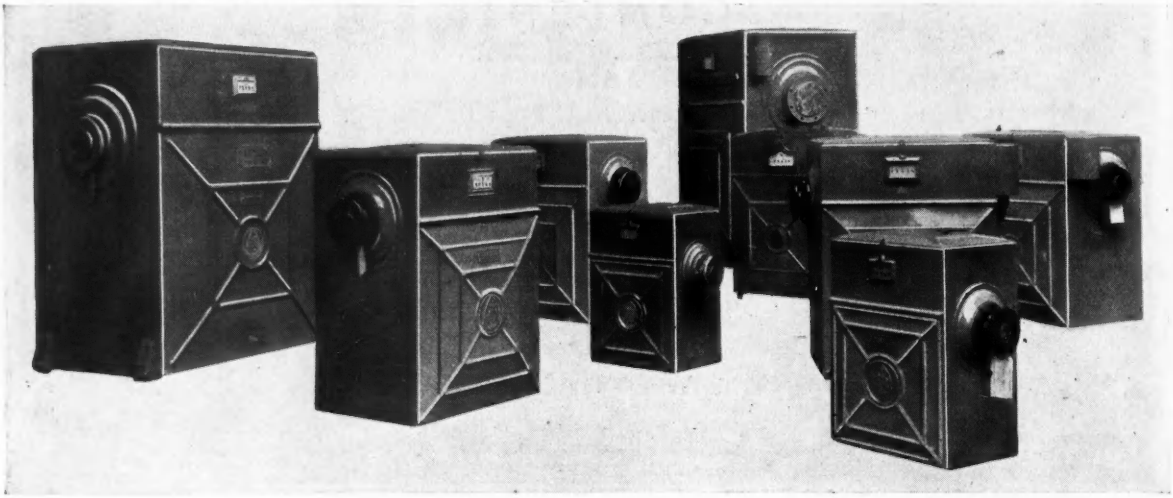

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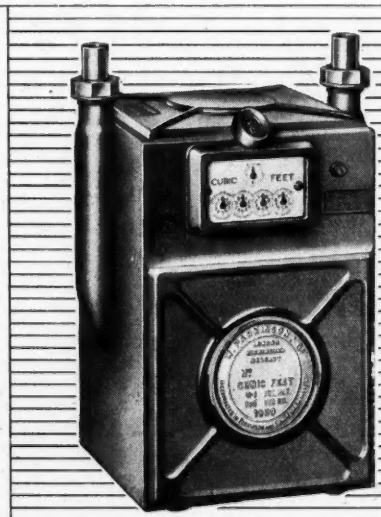

THE SOCIETY OF BRITISH GAS INDUSTRIES · 1905 ·

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COTTAGE LANE WORKS, CITY ROAD, LONDON, E.C. 1
ALSO AT BIRMINGHAM AND BELFAST

p. 5

GAS JOURNAL, AUGUST 6, 1941

VOL. 235 93rd YEAR No. 4081

EDITORIAL NOTES

CREOSOTE IN DIESEL ENGINES

WE have been very interested in reading a Paper by Mr. R. McIntyre, published in the *Journal* of the Society of Chemical Industry, on the use of vertical retort tar oil in high-speed diesel engines; we should like to give prominence to the findings. The Author described the results of an enquiry, commenced in 1935, to determine how far it was possible to use Scottish light creosote in road transport diesel engines. With the type of engine at present used, he stated, it is not practical to use this creosote neat. It can be used satisfactorily, however, in the form of a blend with normal petroleum fuel; and owing to the vastly greater amount of imported diesel oil used, over any possible production of creosote, there is ample outlet for suitable creosote in this direction. The outbreak of war stopped what would otherwise have been a normal development, due to the incidence of various forms of control; but in the opinion of the Author this will be the main outlet in the future for this class of creosote.

It was found that in not one of four standard British high-speed diesel engines tried was it possible to obtain a satisfactory result with neat creosote, and that the refining treatment, by removing completely all phenolic and basic constituents, improved but did not remove the main difficulties inherent in this class of oil. These difficulties are gumming, difficult starting, delayed ignition, and faulty combustion. The results of using neat creosote in two special engines fitted with spark ignition were inconclusive. In one engine the results were encouraging and in the other entirely negative. In one test, increasing the compression ratio improved the results obtainable with neat creosote. Creosote blends of various proportion were tried in four standard high-speed engines and also in one with increased compression ratio. The results indicated that this method of using creosote was possible, and satisfactory bench tests were obtained in certain strengths of blend.

Large-scale trials followed, and in one trial involving three buses and a total of 25,000 miles, it was ascertained that a mixture of 25% of creosote to 75% of petroleum oil ran satisfactorily, provided the blending was thoroughly carried out. Mere pouring of one oil into another is not sufficient, and might lead to serious trouble. In a second trial, over a million gallons of a blend containing approximately 14% of creosote were used during a period of twelve months in a transport fleet comprising several different makes of engine. The running was satisfactory in all important aspects. Starting did not give rise to any difficulty, and there was no trouble with smoke. Crank-case dilution of the lubricating oil has been ascertained to be fairly normal. Regarding nozzles and cylinder wear, an absolute comparison could only be made at the expiration of a much longer period, but up to the present the condition of the nozzles and cylinder wear appear to be reasonably normal. Regarding consumption, computed in miles per gallon, the creosote blend figure seems to be slightly lower than standard diesel oil, but the number of variables—engine, route, weather, &c.—make this difficult to verify. This result can be considered as very satisfactory, especially in view of the large quantities of creosote used, the length of time involved, the cycle of weather conditions, and the different engines employed.

The investigations, culminating in such a satisfactory large-scale trial, have established the conditions necessary for the large-scale use of Scottish creosote and should, stated Mr. McIntyre, enable this to be quickly put into practice without alteration to existing engines when the Government decides that this is desirable. At the present time, the official policy for national reasons appears to be the encouragement of investigational work in anticipation of such a necessity arising, as distinct from a policy of encouraging large-scale consumption immediately.

COMMUNITY OF INTEREST

IN last week's "JOURNAL" we published a report of the eighth annual general meeting of the London and Counties Coke Association and of the speeches at the luncheon which preceded it. The report which the Chairman of the Central Committee, Mr. R. W. Foot, was able to submit was an excellent one and indicative throughout of the efficient manner in which the Association has consolidated the coke position—and it has been no easy task—on "the basis of good faith and fair dealing." The last annual meeting was held in 1938, and since that time considerable strides have been made in regard to the National Federation of Gas Coke Associations, which now comprises seven member Associations, with representation from Scotland and South Wales. After the outbreak of war the Federation agreed to co-operate with the hard coke producers on all matters of mutual interest, and that co-operation has resulted in that all-important "united voice." When the Mines Department have authorized increases in coke prices it has been possible to negotiate these on a district basis in conjunction with the hard coke producers. Co-operation is being steadily fostered in every phase of activities, commercial, financial, and technical, between all producers of solid smokeless fuels.

The plans are there for enabling the Association to meet successfully any conditions that it may have to face in the immediate post-war period, and it has been fully recognized that research and development work must be undertaken to maintain an active coke policy after the war. In regard to production itself, the problems of coke quality are being dealt with, and matters such as the dust-proofing of coke, its activation, and the standardization of sizes are being actively pursued. Attention was called by Mr. Foot at the meeting to the fact that the demand for coke in the Association's area had outrun the supply, and to meet the situation about 250,000 tons had been imported from the north-east coast. He strongly advised members to take advantage of this coke now while transport is available. Most of the coke is large, but each member should look into his own position and decide how he can take it and utilize it—perhaps for water gas manufacture, thereby releasing some of his own coke for re-sale, or by persuading customers who could handle it to stock as much as possible. No gas undertaking which envisages the likelihood of shortage of its own supplies should neglect this opportunity.

The "community of interest" underlying the activities of the London and Counties Coke Association and serving as a driving force was manifest at the Association's luncheon, which was attended by about 150 members and guests representing all the affiliated Associations and other bodies with which the Association, fortunately for the future, is in the closest touch. This drawing together of an ever-widening field is a happy augury; the very attendance under prevailing conditions of so many busy and prominent men was tribute to the efficiency of a live organization, the national importance of which will, we feel certain, continue to grow.

Personal

Engineer-Captain J. FRASER SHAW, R.N. (ret.), who was Chief Engineer of the Fuel Research Station for many years, died on July 23.

* * *

Birkenhead Gas Committee recommends the appointment of Mr. P. SUMNER, of St. Helens, as Works Manager in the Gas Department.

* * *

At last week's meeting of the Middlesbrough Council Mr. JOHN W. PALLISTER, the Gas Engineer and Manager, was highly praised for the efficient and expeditious manner in which he tackled damage to a gasholder during an emergency.

* * *

Mr. ALEXANDER MURRAY, Manager of the Aberlady and Gullane Gas Company, Ltd., has obtained a similar appointment as Manager of Amble Gas-Works, Northumberland. He is being succeeded at Aberlady by Mr. R. W. HANNAY, Gorebridge.

* * *

Mr. C. M. HEMSLEY, who was appointed Acting Secretary of Associated Gas and Water Undertakings, Ltd., at the outbreak of war, has now relinquished the Secretaryship of the Ilfracombe Gas Company, one of the subsidiaries of the Associated Company.

* * *

Mr. A. E. LOGSDON, General Manager and Secretary of the Farnham Gas and Electricity Company, has been elected to a seat on the Board and appointed Managing Director. The Company is a subsidiary of Associated Gas and Water Undertakings, Ltd.

* * *

A pleasant ceremony took place in the lecture theatre of the Cambridge University and Town Gas Light Company on July 29, when Mr. G. E. H. KEILLOR was presented with a silver cigarette box from the staff as a token of their good wishes as he relinquished the position of Works Engineer to take up a new appointment at Worcester. The General Manager, Mr. J. Hunter Rioch, presided, and the presentation was made by the Works General Foreman, Mr. A. Bowman. A suitably inscribed clock was presented to Mr. Keillor on the previous week by the members of the Recreation Club in recognition of his services as Chairman for the past three years.

* * *

Mr. J. R. PROBERT has resigned his position with the Woodall-Duckham Company in order to take up an appointment as Assistant Managing Director on the Board of Messrs. Henry Lees and Co., Ltd., Engineers and Contractors, Glasgow. Mr. Probert has served the Woodall-Duckham Company for the past 22½ years. After an initial period of three years as Site Engineer in charge of contracts for W.-D. continuous vertical retort installations, he became Assistant to the Chief Operator and was for some years responsible for all guarantee tests. Later he supervised the construction of the first W.-D. inclined chamber oven and intermittent vertical chamber plants. When the Company became actively interested in the design and construction of by-product coking plants, Mr. Probert in 1927 took over direct responsibility for their construction, including the purchase of all material and site organization, and has supervised the building of no fewer than 27 modern silica coke oven batteries and almost as many by-product plants.

Obituary

The death has occurred, after indisposition which lasted some time, of Mr. REGINALD BERNARD SILCOX, Manager of the Ivybridge (Devon) Gas-Works. Before going to Ivybridge he held a similar post at Kingsbridge.

Awards for Gallantry

The King has given orders for the following awards for brave conduct in civil defence:

M.B.E.

R. G. A. Clark, Engineer and Manager, Dover Gas Company.

A. G. Hartley, Chief Assistant Engineer, Plymouth Corporation Gas Undertaking.

E. W. Morrison, Works Superintendent, Nottingham Corporation Gas Department.

P. T. Hague, Chargehand, Nottingham Corporation Gas Department.

George Medal

S. Hay (Station Engineer), D. C. Bertram (Deputy Station Engineer), W. Brodie (Works Fireman), R. G. James (Pumpman), Gas Light and Coke Company.

British Empire Medal

L. J. Clark (Assistant Mechanical Engineer), J. Coppin (Works Fireman), P. J. Eldridge, (Dehydration Plant Attendant) J. A. Nichols (Senior Assistant Engineer), R. CORKE (Electrician), and A. T. Linney (Works Fireman), Gas Light and Coke Company.

Letter to the Editor

Peat for Gas Purification

SIR,—The preliminary report from the Research Manager, I.C.I. (F. & S.P.) Ltd., appearing in your issue of July 23, on the use of peat in conjunction with oxide for gas purification, serves to establish on a scientific basis a phenomenon which has been recognized and put to good effect in the purification of gas for a number of years.

During the last war the founder of this Company, the late Mr. W. T. P. Cunningham, in an endeavour to obtain a substitute for imported bog ore located deposits of peaty bog, which, as it was found to contain a certain percentage of ferric hydrate, suggested its possible use for gas-purification. This was immediately adopted for the purpose, and in course of time was enriched by the addition of natural concentrated ferric oxide in the form of a fine powder. Subsequent developments have resulted in the use of such material for purification purposes on an ever-widening scale.

From the early days it was noticed that the activity of the peaty mixture under practical conditions was much greater than one would have expected merely from a consideration of the ferric hydrate content, and as indicated by small-scale laboratory tests. This suggested that the peat present, primarily intended for lightening purposes, possessed beneficial properties with regard to the absorption of H_2S—a possible explanation being by way of catalytic action. One such feature subsequently determined was its activity for the absorption of oxygen, thus accelerating the "revivification *in situ*" reaction. With regard to the particular application at Billingham, it will be noticed an ammonia admission to the boxes of 0.03% is required—*i.e.*, equivalent to 10 grains per 100 cu.ft., which, although higher than theoretical requirements necessitate, is not uncommon practice in these days, so far as the purification of coal gas is concerned. The bacterial process operating successfully on water gas would possibly require the more efficient elimination of tarry matter for its application generally for coal gas purification, seeing it is unlikely that the bacteria responsible would flourish in the presence of phenols and such like.

In a report on a paper entitled "Living Organisms in Gas Purification,"* reference was made to some characteristics of sulphur bacteria "that they live and thrive in dilute sulphuric acid solutions, and are active until the concentration reaches 5.2% H_2SO_4." It is an established fact that the introduction of an excessive amount of ammonia may, under conditions operating in the purifiers, give rise to acidity as the result of the formation of ammonium sulphate (and ammonium sulphocyanide with coal gas and coke oven gas), resulting in the production of ferrous sulphate (and sulphocyanide)—distinctly acid salts. One wonders whether the introduction of ammonia to the extent of 0.03% has, in fact, produced acidic conditions in the oxide, as outlined above, creating a suitable atmosphere for the thio-bacteria to operate. It is a not uncommon experience that with a charge of new bog ore or natural oxide in the last box in a series, gas free from H_2S passing through the box is found to be contaminated on the outlet. This appears to be due to the operation of bacteria present, producing from the fixed sulphur compounds in the gas carbon disulphide and mercaptans, etc., free H_2S. The remedy suggested is to refrain from placing boxes of new oxide as last in the series, for it is found that if first used in the sulphiding position, no abnormality occurs during subsequent rotation.

It is of interest therefore to recognize that conditions operating in purification systems may favour the removal of the inherent H_2S by bacterial reaction, while the same media may be responsible for the formation of H_2S in gas previously purified. Such small amounts of H_2S as may be produced by bacteria as a secondary reaction, while being sufficient to cause grave concern to those operating under the stringent regulations of the Gas Acts, would of course be insignificant for the purpose for which the gas is used at the works of I.C.I.

The Gas Industry is indebted to I.C.I. for making known the highly interesting research work carried out, and the publication of the promised detailed account will be awaited with interest.

Yours, &c.,

For the British Gas Purifying Materials Co., Ltd.,
E. W. SHARMAN, Assoc.M.Inst.Gas E.,
Technical Manager.

99, London Road,
Leicester.
Aug. 2, 1941.

* "Living Organisms in Gas Purification," by Gilbert E. Seil; extracted "GAS JOURNAL," June 19, 1940.

A Meeting of the General Committee of the National Federation of Gas Coke Associations will be held on Tuesday, Aug. 12, at Gas Industry House, at 2.30 p.m.

A Wartime Reduction in Price was announced at the recent annual meeting of the Boston (Lincs) Gas Light and Coke Company, when the Chairman (Alderman T. Kitwood) said that the very satisfactory working results obtained over the year justified the Directors in recommending dividends making, for the twelve months, £10 4s.% on the ordinary shares, and £8 8s.% on the new ordinary shares. The Directors had also decided that, as from the last meter readings, the price of gas should be reduced by 0.4d. per therm—a similar reduction to that which came into operation in June, 1939. Paying tribute to the work of the staff and employees, he said it was a praiseworthy achievement that such excellent results had been obtained in spite of wartime difficulties. We would add our congratulations to Mr. W. C. Chapman, the Engineer and Manager, on what is in reality a second reduction in price under wartime conditions, seeing that the earlier reduction came into effect only a few weeks before the outbreak of hostilities.

INSTITUTION OF GAS ENGINEERS

We publish to-day Authors' replies to the discussion on their Symposium Papers at the Annual Meeting.

Sir Frederick West

Sir Frederick J. West (in reply) wrote: The very keen and interesting discussion evoked by this Paper is ample reward for the time and labour expended in the analysis of the Returns and the preparation of the Paper, while the practically unanimous agreement with its main thesis is extremely gratifying. It is felt that steps should be taken to come to a final conclusion and to give effect to the suggested reform. One practical step that could be taken without waiting for official action is that those engineers who are confronted with the necessity of applying for reductions in declared calorific values to meet the requirements of benzole recovery should select one of the proposed standard values for their new Declaration.

Some of the questions raised by contributors to the discussion relate to specific gravity and combustion characteristics generally, which the Author excluded from his survey of the subject because they could not be adequately covered within the limits prescribed for these short Papers. These important matters will, therefore, have to be dealt with on some other occasion.

Professor Townend points out that the problem may be further simplified when the new methods of gas manufacture to which he refers are sufficiently developed, and Mr. Finlayson is of the opinion that if the proposed four standards were agreed upon they would quickly be reduced to two. If such were the result, it is obvious that (i) meters could be graduated forthwith in therms, only two types of meters being required, or (ii) the system of charging by therm could be abandoned, whichever is deemed the correct policy in view of all the circumstances.

Mr. Mead and others have referred to the question of the influence of the relative values of coal and coke on the policy of making more or less gaseous therms per ton of coal carbonized. Many undertakings sell more therms in the solid form—*i.e.*, coke—than in the form of gas, and depend largely upon the solid fuel market for financial reasons, and no doubt this policy is justifiable where the real return on coke is high in relation to coal cost. Whether this policy, however, is the best for the Industry in the long run is debatable.

Dr. Foxwell suggests that the four proposed calorific values are arbitrarily chosen. It is shown, however, that as a matter of experience during the 20 years of operation of the Gas Regulation Act, 95% of the values selected are within 10 B.Th.U. of the four suggested standard values.

Dr. Harold Hartley

Dr. H. Hartley (in reply) wrote: There has not been district experience with "sulphur-free" gas to provide the comparable figures for which Dr. Foxwell asks. Others of those who took part in the Discussion support the argument developed in the section dealing with maintenance. For example, Mr. Chester indicates that after four years' experience with gas containing 7–10 gr. of sulphur, he found the reduction in water heating maintenance costs most marked. Mr. Dickson supports the view that it would not be unreasonable to anticipate a saving in the cost of maintenance of appliances, and dealing with complaints arising therefrom, of 0.1d. per therm sold to domestic consumers, if sulphur were to be eliminated.

It is encouraging that Mr. Gill should support so strongly the plea for the removal of the sulphur impurity. Attention is drawn particularly to his remark:

> "The cost of its removal, particularly in large Works, is by no means burdensome, and we ought, in my view, to get on with the job."

Mr. Ingham indicates that in his view it would not be satisfactory to work to a standard of 5 or 6 gr.

A Sub-Committee of the American Gas Association has recommended that the sulphur content be kept below 2 gr. There is, however, plenty of evidence to indicate that, from the manufacturing standpoint, the upper limit can be kept below 1 gr., and the aim should be a gas practically sulphur-free. There are three references in the Paper under discussion dealing with the processes which can be operated.

It is unlikely the Gas Industry will make a real success in the field of hot water supply for domestic purposes until town gas is, for all practical purposes, sulphur-free. It is of interest to recall a report published in *Gas und Wasserfach* in 1938, which dealt with an examination of two water heaters of the instantaneous non-condensing type, one of which had been used with gas containing 7.3 gr. of sulphur per 100 cu.ft., and the other with gas containing on an average 0.4 gr. of sulphur per 100 cu.ft. Approximately 10,000 cu.ft. of gas were burned in each heater, and the difference in the condition of the appliances at the end of the test was most marked. It was stated that the heater used with low sulphur gas appeared like a new one. The deposit collected from the heater in which there had been burned the normal German town gas yielded on analysis the following percentages:

Cu	... ...	17.8	Fe	... ...	4·2
Sn	... ...	4·4	Al	... ...	4·3
Pb	... ...	0.8	SO_4	... ...	35·4

Mr. W. L. Boon

Mr. W. L. Boon (in reply) wrote: I feel that in substance the contributions to the discussion on my Paper all fully support the principle that standardization of coke grades and properties will become essential in any well-ordered development of the coke industry, and consequently there would perhaps be no useful purpose served in my replying to these in detail.

I am very gratified that so much interest in coke matters has been evidenced within the scope of this Symposium, and those sections of the Gas Industry whose duty it is to deal with coke will be much encouraged and directly assisted by the valuable and constructive views which the various Papers have elicited.

In due course it will be my duty to bring all this material before the appropriate bodies dealing with coke matters, and I appreciate the strong impetus which the contributions to the discussion have given towards standardization of coke properties, which must react in an improvement in our future coke business. In view of the post-war reconstruction and the problems which must then face the Industry the help which these contributions will make to the coke side of our work is therefore most opportune.

Mr. R. J. Rogers

Mr. R. J. Rogers (in reply) wrote: May I first express thanks to those who have contributed to the discussion of my Paper. The interest shown was very gratifying, and it is evident that there is a large section of the Gas Industry to whom rational standardization would be acceptable. I am grateful for the support given to my proposals by Miss Willans, as representing the housewives' point of view, which is of paramount importance. Standardization of oven sizes could result in a standardization of cake trays and baking tins, while standard components, such as door latches and thermostat calibration, would obviate the necessity of the housewife learning a new technique when she purchased a new cooker.

The degree of standardization outlined in my Paper would not penalize the outstanding developments of the South Metropolitan Gas Company, mentioned by Mr. Chandler. If experience proves that any major advantage would be gained by the adoption of luminous burners and solid hotplates, there is no reason why, in due course, these features should not be embodied in gas cookers without alteration in the standard sizes of ovens or hotplates.

Mr. White has given information regarding the practical results of standardization of simple hire and slot cookers by the Newcastle Gas Company, and I am well aware of similar experiences by other large Gas Undertakings. I am hopeful that in the future design of gas cookers by various appliance makers, the interchangeability of component parts will be adopted.

Mr. Lupton suggests that standardization may be limited by variations in gas quality. It is our experience, however, that such variations can be readily met with standard ranges of fixed nipples and governors.

I agree with Mr. Pearson that standardization of external shape and dimensions of injectors is also desirable.

I cannot agree entirely with Mr. Purkess that suggestions from the sales side are lacking in discrimination. The salesman is our link with the consumer, and we have always valued his opinions, which we have often found thought-provoking and always worthy of the closest attention. I think that we would be in agreement, however, that a technical background is desirable to the gas salesman. The idea of statistical analysis of consumers' reactions is one to which I have already given considerable thought.

The suggestion of Mr. Wilson for a standard "cheap" cooker with interchangeable parts, one maker with another, is an ideal which may be approached, but is not easy of attainment. Manufacturers may be depended upon to investigate the possibility of making interchangeable as many of the replacement parts of cookers as possible, particularly the oven fittings. I entirely agree that if standardization is to be used solely as a means of reducing the selling price of the cookers to the exclusion of essential features, it will be a retrograde step.

Mr. Chester objects to the cheap cooker. If by cheap cooker he has in mind an inefficient or short life article, I agree. No cooker should, in my opinion, be marketed which does not conform to certain standards of performance, including efficiency and durability. An up-to-date low-priced cooker will always have a market. Mr. Chester's remarks regarding price standardization will meet with the general approval of appliance manufacturers.

It is pleasing to note Mr. Lucas's remarks that the question of regional standardization of price was being fully ventilated in the districts when war broke out. Mr. Oatley has suggested a basis of price standardization which is perfectly sound, and worthy of the careful consideration of the regional committees.

The concrete suggestions made by Mr. Spinks that the coin attachment to slot meters, main cocks and the height of cooker connexions should be standardized, are worthy of careful consideration. I appreciate his support of my plea for uniform prices, and his advocacy of a campaign for the abolition of flueless rooms and unventilated kitchens, which also receives the support of Miss Wilson. This matter should be borne in mind by the representatives of the Gas Industry who come into contact with the building authorities. House designers should take cognizance of the fact that the gas cooker is an integral part of the kitchen and should not be considered as an after-thought installation. A special recess or other designed position should be left in the kitchen to house this appliance, which might even be built-in, and proper ventilation should be provided in every kitchen.

A built-in drying cupboard might also prove a valuable innovation, and is worthy of the attention of designers of post-war houses.

I agree with Mr. Andrew that considerable strides have been made in gas fire design, but I submit that finality will never be reached. As he points out, many new types of space heating appliances were under development and experiment immediately prior to the war, but I suggest that it would be inadvisable to standardize on such new types, as is recommended by Mr. Andrew, until experience has proved their real value. There is no reason, however, why the standard features I mentioned under the heading of "gas fires" in Table I should not be incorporated in any new designs.

With regard to automatic oven ignition, mentioned by Mr. Hill, it is appreciated that this would be a desirable feature to incorporate in the cooker of the future; much more work requires to be done, however, before this can be standardized.

I do not agree with Mr. Pepper that total standardization would be achieved merely at the expense of individuality. It would result in a loss of incentive to improve design and performance.

Mr. Bell's proposal that the question of standardization should be fully discussed by the various District Associations of Gas Engineers and Managers is a good one, provided that prompt decisions can be obtained, as manufacturers will have to proceed without loss of time to prepare their designs, tools, etc., for new appliances for post-war use.

While I fully appreciate the very real difficulties met by Mr. Caudwell in the multiplicity of appliances, good and less good, which have flooded the market in the past, I do not consider that the total standardization of cookers and water heaters is desirable or attainable at the present time, for reasons definitely outlined in my Paper.

Mr. Cook expresses practically complete agreement with my proposals for the rational standardization of appliances, and gives his reasons leading to that opinion. It is interesting to note that he does not agree with long-term hire-purchase (such as ten years). During the past five years certain stream-lined cookers of sound construction have been placed on ten years' hire-purchase by many Gas Undertakings, and it is my view that these particular appliances will maintain their eye appeal, so far as appearance and design are concerned, and will function satisfactorily with comparatively little maintenance charges for a period even in excess of ten years. In deciding upon the period for which various appliances are offered for hire-purchase, due regard must be paid to the design and construction of the apparatus in the light of the service demands which will be made upon it.

In reply to Mr. Forshaw, I would point out that I desired particularly by my reference to the C.P. scheme in operation in America, to direct the attention of any Committee which was set up to consider standardization in this country to the very successful collaboration which had taken place in America between the appliance manufacturers and the Gas Undertakings. I agree that the C.P. scheme adopted in America would not meet with anything like universal approbation in this country.

Stream-lining and the incorporation of a hotplate cover I have always regarded not as "talking" features, but as a definite forward step in keeping with immediately pre-war ideas of kitchen architecture. While it is true that the sizes of hotplates on some of the existing stream-lined cookers might, with advantage, be improved by increasing their dimensions, there is no reason why larger hotplates could not be provided, whilst maintaining a stream-lined effect. From preliminary tests which have been made, I do not anticipate any great difficulty in obtaining equal performance with a single or double burner in the same dimensioned oven.

Mr. Hodgson has stated a case for several items which I have not included. In putting forward the several items for which standardization presents advantages, I realized that the list would be tentative, and that it may be decided to omit certain items or to add to the list.

Whatever degree of standardization is approved, and whatever the machinery adopted for its working, I would urge that the rational standardization of domestic gas appliances should receive the closest attention and the full support of every section of the Gas Industry.

Dr. G. E. Foxwell

Dr. G. E. Foxwell (in reply) wrote: There is little in the discussion to which it is necessary for me to reply specifically. I am surprised to find how generally those who contributed to this Discussion were in agreement with the views expressed in the Papers, and that in spite of the President's request to be provocative how little provocation the Authors generally appear to have caused.

There seems to have been agreement among all the speakers who dealt with the subject of "co-ordination of the Carbonizing Industries" that steps should be taken to reorganize both the gas and coke oven industries. Mr. Bennett has rightly put forward the view that the coal, electricity and oil industries are all far more co-ordinated than the Gas Industry, and has hinted that since with the probable formation of a Ministry of Fuel and Power the carbonizing industries must take their economic place in the fuel supply of the country the present position of the Gas Industry is none too happy. Dr. Smith has expressed doubts as to the strength of the position of the Gas Industry in official circles. The inescapable conclusion is that steps must be taken to co-ordinate these industries both within themselves and with each other in order that they may be subject to central control each within its own circle and can thus speak with a united voice. It is probably because of the failure to achieve this in the past that the coal supply of the Gas Industry has for some years been so unsatisfactory, this being just one example of the disadvantages of an unco-ordinated industry dealing with a more powerful body.

Mr. Shaw, Mr. Restall, Mr. Ingham and Mr. Paterson are all of the opinion that something must be done to achieve co-ordination and that some positive steps must be taken, but in Mr. Paterson's mind the impression created by the Symposium is that the Authors of the Papers are not optimistic of tangible results. Tangible results can only be achieved by considerable effort put forward by the leaders of the Gas Industry and supported by the rank and file. Personally, I believe that that effort will be made because the leaders of the Industry recognize that it is imperative. The tendency of modern industry is towards some form of co-ordination and discipline. The Gas Industry must march with the times. Miss Dorothy L. Sayers, in her book *Begin Here*, points out that "Whoever wins the war, the peace will be won by those who, throughout the struggle, remained alert and ready, with a clear idea of what they want. . . . We cannot return to the past. Nor can we sit still. So we must go forward." Can the gas or the coke industry fulfil these conditions so long as they remain independent units, and so long as they are not inter-co-ordinated?

Mr. John Terrace

Mr. John Terrace (in reply) wrote: The discussion is, in the main, favourable to the views I expressed, and if my Paper has succeeded in bringing out the useful views of others I am well content.

The answer to Mr. Robinson's query is that the subjects he mentions are dealt with as Ancillary Subjects which the student has to pass as part of the Examination in Gas Engineering.

Mr. W. Rupert King

Mr. W. Rupert King (in reply) wrote: Before beginning to write the Paper, I considered the advantages or otherwise of comparing notes with my fellow Editors in the Gas Press, deciding finally against doing so. It is, therefore, particularly gratifying that they felt able to give so large a measure of support to my chief points, and I thank them for strengthening my several pleas to the Industry. •I do not propose to satisfy Mr. Staniforth's (*Gas Times*) request for my definition of "irresponsible criticism." It was irresponsible opposition to, and not criticism of, a policy to which I referred, and in any case I placed the onus of judgment between useful and irresponsible upon those who might be seeking Press support for their policies. The main point is that the Gas Industry needs the services of its Press to help it to develop goodwill for itself externally among the innumerable other industrial, social, and political interests which go to make the Nation. If the Industry under-estimates the capacity of its Press in this respect, it makes a grave mistake. But the capacity can only be fully developed if the Press has the confidence of those who shape the Industry's policies, and my contention, supported by Mr. Silcox (*Gas World*) and by Mr. Staniforth, is that such confidence has not been given in sufficient measure. It was my firm conviction of this need for a trusted Press which decided me to fly the kite of a controlled or official organ —the very idea of which was singled out for condemnation by almost every speaker. The "Press Conference" to which some speakers referred, in so far as it has already been tried in the Gas Industry, has been so hedged about with inhibitions that it has generally been useless from the point of view of Press discussion of policies.

I heartily welcome the suggestion made by Mr. Alexander and by Mr. Sandeman that organizations submitting manuscripts on behalf of contributors might arrange to edit them first. This would be a step towards the elimination of the verbosity of which I accused the Industry.

This thought has a bearing also on the question from Mr. Greaves as to whether we had ever tried to obtain abstracts of lengthy Papers from their Authors. My answer is that a year or two ago we did make very serious efforts, especially in the direction of the Junior Gas Associations, to obtain abridged versions of Papers approved by the Authors, but so little success attended them that we had to abandon the idea. Mr. Silcox reports a limited measure of success in that on one occasion he obtained Authors' abstracts of a few Institution Papers. In view of this, and in the absence of any such official help as suggested by Mr. Alexander and Mr. Sandeman, we of the Press might well get together after the war in a concerted attempt to make this an accepted practice. I still feel, however, that we shall have little success except with the backing of the organizations.

Mr. Scott has now confessed himself the author of the rationalization scheme to which I referred in my Paper. I still find it difficult to see how any measure of re-organization could be found acceptable from within. Of the separate compartments to which he would confine the several periodicals, some are obviously the "tit-bits," though possibly it is easier for us to recognize them as such than for those who do not have to get together a *Journal*, a *World*, or a *Times* week after week, month after month, year after year. I cannot conceive of any of us voluntarily eschewing some of the subjects so long as we are dependent for our existence upon survival in commercial competition one with another. Mr. Scott considers it a waste of available space that each gas periodical has within its pages much the same matter. Surely this is as inevitable as it is in the National Press? News is news, and it is mainly in the manner of its presentation that one daily newspaper differs from another, leaving the buyer a wide choice for his daily reading.

The general agreement which speakers expressed with my main points leaves little scope for an Author's Reply, but I should like to express once again my gratitude to the President for the opportunity given to the Press of putting before the Gas Industry some of the difficulties which might prevent its being of maximum use to that Industry in the future.

NITROGENOUS GUM

A STUDY WITH REFERENCE TO THE REACTION OF NITRIC OXIDE WITH PURIFIERS

By NORMAN B. BIGGS, B.Sc., F.C.S., *Late Chief Chemist, Dudley Gas Works*

THE formation of gum in coal gas has received attention from many workers, and two classes have been distinguished(1): (*a*) Liquid phase gum which consists essentially of oxidized polymerization products; (*b*) vapour phase or nitrogenous gum.

The former consists mainly of carbon, hydrogen, and oxygen, with only traces of nitrogen (less than 0.4%), and is formed from the unsaturated hydrocarbons, principally indene and styrene. The latter class is formed by the action of nitrogen dioxide or nitric oxide on hydrocarbons and contains carbon, hydrogen, and oxygen, but with about 5% of nitrogen.

Schuftan(2) has pointed out that the analysis (ash-free) of this type of gum agrees very closely with di-cyclopentadiene nitrate, and that it seems from the oxygen-nitrogen ratio of the average of many analyses, the reacting substance is nitric oxide via an intermediate NO_3 rather than nitrogen dioxide.

Morgan(3) has drawn attention to the high oxygen content, and has suggested the possibility of nitric oxide reacting with an unsaturated ethylene link through the intermediary of nitrogen trioxide, N_2O_3.

Whatever the exact mechanism may be, it is now accepted on the evidence of the workers already cited and others(4) that nitric oxide is the primary cause.

It is proposed here to discuss the results of investigations on nitrogenous gum carried out at Dudley Gas-Works as a result of trouble experienced during the late summer and early autumn of 1940. The history of this special case is: In November and December of 1939 a vacuum was worked on the retorts (steamed continuous vertical) in order to save therms on retorts which were ready for re-setting and had developed serious cracks. In this way, considerable quantities of nitrogen were drawn through the retorts with the consequent formation of nitric oxide. Shortly after the Hollings "induction period"(5) some gum formation was noticed on the district and a reversion was made to pressure conditions in the retort house. No further interference was experienced until the late summer of 1940, when very considerable gumming of governors, and, in particular, by-pass tips re-occurred. As pressure had been maintained on the retorts since January, investigations were commenced.

At this time, along with the type of gum which had been experienced previously a more unusual deposit was noticed. Pilots on the district, and flat burners became clogged up with a sooty substance. A crucible left over a small Bunsen flame during one night developed a ring of soot, although the flame was aerated. Strong heating, however, destroyed this ring in time.

This sooting was repeated later with other crucibles, and a photograph of one of them is reproduced (fig. 1).

This might have been explained away if the gas composition had varied, for example if the unsaturated (illuminant) fraction had increased, but apart from the usual slight daily variation no appreciable change in the constituents of the gas was noticed.

An examination of the flat-flame burner showed a brown stain on the muslin filters in the body of the burner (A on fig. 2) which had characterized previous gum formations, but in addition a carbonaceous substance rather like charred crinkled paper was noticed in the porcelain burner tip (B). This substance was very similar to that discovered on the crucible and in the by-pass tips, and as it coincided with the other gum in appearance and disappearance, which were, incidentally, both quite sudden, it was thought that the carbonaceous deposit might be another form of nitrogenous gum. Further evidence, however, indicated that it was not nitrogenous gum, for it was not soluble in alkali although in some cases alkali loosened it, nor did it evolve nitrogen dioxide on heating. A similar observation of the decomposition of nitrogenous gum is due to Fulweiler (*loc. cit*), who also noted that a black carbonaceous deposit is left. It thus seemed probable that this substance was such a decomposition product.

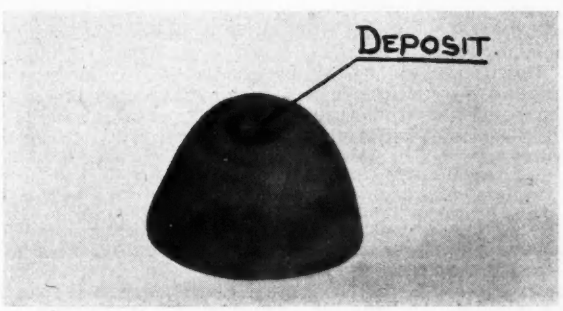


FIG. 1.

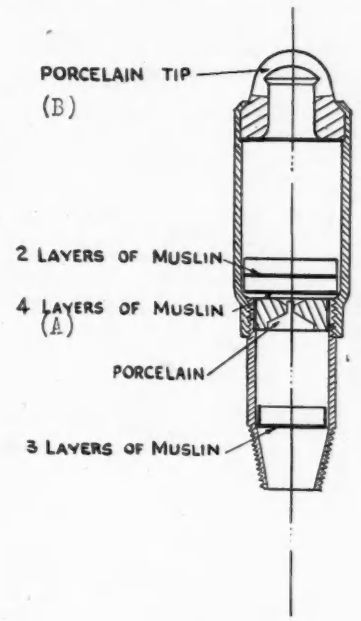


FIG. 2.

If the gas was passed through a tube containing a long plug of cotton wool and fitted with narrowed inlet and outlet tubes which caused the gas stream to impinge on the walls, the new deposit became much less scarce and the burners lasted much longer. The inference was, therefore, that the new deposit was formed from particles of gum sufficiently minute to pass the muslin filters in the burners and which were decomposed at the burner tip or in the flame.

Having settled the nature of the deposits, the question then arose as to the source of the nitric oxide which gave rise to them. As pressure conditions had been maintained in the retort house for eight months, it could not be explained as in previous cases by the synthesis of nitric oxide in the retorts.

The effect of hot sun on the gasholders in summer months has been shown to cause some gum formation (Hollings, *loc. cit.*), but the amount of gum was abnormal, and as it also made its appearance in gas prior to the holders this was ruled out as the pre-eminent cause. On the other hand, during June, high temperatures developed on the purifiers for a period of several days, owing to the hot weather. One box which was filled with particularly active new oxide rose to over 100°F., while other boxes of partially spent oxide had temperatures ranging from 80°–95° F., the normal working being 70°–75°F. It is generally known that nitric oxide is absorbed in iron oxide purifiers, and that under high-temperature conditions the compounds formed break down, giving off NO and NO_2, which can then give rise to more gum (Hollings, *loc. cit.*). Evidence brought forward indicates that the compounds responsible are Roussin salts—nitrosyl sulphide complexes of iron with alkali metals or hydrogen. They take their name after their discoverer, and have

been studied by various workers(6). Similar compounds with other metals and some organic radicals have been prepared also.

Roussin first obtained a substance which he called "binitrosulphure de fer," the accepted formula for which is $Na(Fe_4(NO)_7S_3)$ H_2O—sodium ferroheptanitrosyl sulphide, otherwise known as Roussin's black salt. It is slightly soluble in cold water (0.893 in 100 parts), but much more soluble at 100° C. (50 in 100 parts). The solution is dark brown; even in dilutions of 1 part in 20,000 parts of water the solution is distinctly coloured. Alcohol and ether dissolve it, but alkali, carbon disulphide, and chloroform do not. It is decomposed by heating at 115°C. or by exposure to air, and in both cases nitric oxide is evolved. A yellowish red "nitrosulphure sulphure de fer," $Fe_2S_3N_2O_2 4H_2S$, was obtained by Roussin on treating the black salt with cold dilute acid.

Pavel and Bellucci prepared a brown amorphous mass supposed to be hydrogen ferroheptanitrosyl sulphide, $H(Fe_4(NO)_7S_3)$, from the black salt by action of dilute sulphuric acid. Pavel showed that this compound was soluble in chloroform and carbon disulphide, but insoluble in water, alcohol, and ether.

Roussin's red salt, "nitrosulphure de fer et sodium," has been prepared also from the black salt, to which it is reconverted by dilute acid or carbon dioxide. Bellucci and Cesaris showed the constitution of the potassium salt to be $K(Fe(NO)_2S)_2$ H_2O—potassium di-nitrosylsulphide. A search was commenced

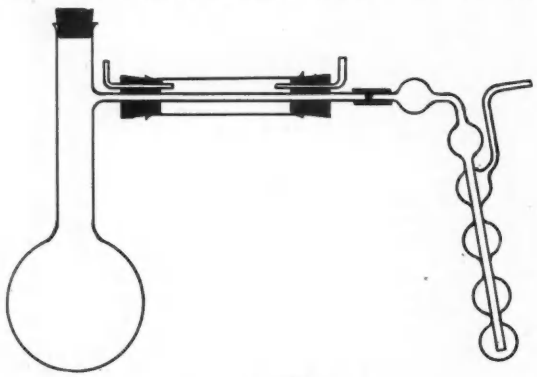


FIG. 3.

therefore for such compounds. When the one purifier which had gone through the December period of nitric oxide synthesis and was still in commission until the end of October was emptied a sample of the uncrushed oxide was taken and bottled immediately. Some of this oxide was heated at 100°C. (higher temperatures could not be employed owing to the presence of tar), but despite exhaustive tests, no evolution of nitric oxide or nitrogen dioxide could be found. This, however, is in agreement with Schuftan's observation, that Roussin salts found in oxide purifiers tend to evolve their nitrogen mainly as nitrous oxide, nitrogen, and ammonia.

The effect of oxidation was then tried on the oxide. The method adopted was this: A distilling flask fitted with a small condenser on the side arm was connected with a bubbler which contained a little dilute caustic potash solution—as shown in fig. 3.

The sample under test was heated in the flask with water and a few c.c. of hydrogen peroxide. The caustic potash after the experiment was tested by Feigl's(7) micro-modification of the Griess reaction. A possible doubt on this procedure, namely, whether hydrogen peroxide under these conditions would produce traces of nitric oxide or nitrogen dioxide from ammonium salts and cyanides, was satisfactorily settled. Mixtures of these salts likely to be encountered in the oxide were heated with hydrogen peroxide, but in no case did any trace of colour develop with the Griess reagent.

Samples of oxide which had been taken from the box known to have gone through the November–December period of nitric oxide formation gave very positive results, while samples of other spent oxide gave no result. Having thus established that nitrosyl compounds did exist in detectable quantities in the former oxide, attempts were made to isolate them. After various preliminary extractions of the nitrosyl-bearing oxide with ether, acetone, and alcohol, it was decided to proceed on systematic extractions starting with inorganic reagents, in order to obviate interfering tar and sulphur.

Different portions of this oxide were extracted with (1) water; (2) dilute caustic potash; (3) dilute sulphuric acid. The results are summarized below.

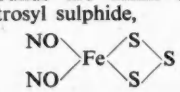
(1) The water extract was a pale solution coloured by some dark purplish-brown substance. On heating with hydrogen peroxide it developed first a lighter fluorescent purplish colour and finally went yellow with the precipitation of white plate crystals, but the caustic potash in the bubbler gave no reaction with the Griess reagent. Any ammonium salts would be contained in this fraction, and the absence of reaction confirmed that nitric oxide and nitrogen dioxide evolution was not from this source.

(2) The alkaline extract was pale yellow in colour. When treated in the above manner the Griess reagent showed a very faint trace. This was probably due to particulate gum formed before the purifiers and deposited on the oxide rather than to any nitrosyl salts, for the former is known to be readily soluble in caustic potash (Schuftan; Fulweiler, *loc. cit.*), while the latter type of compounds are not.

(3) The acid extract gave a very considerable positive test, and was therefore chosen for detailed examination. The solution was coloured a deep blood red by the presence of ferric thiocyanate, and in order to eliminate this and any other interfering compounds the acid solution was extracted with chloroform. The ferric thiocyanate remained in the acid fraction, while the chloroform solution was coloured pale yellow. Testing with hydrogen peroxide as before, it was found that the chloroform portion contained the nitrosyl compounds. This solution was evaporated and the residue examined under a low powered microscope. There were seen pale yellow crystals, some growing together and some forming elongated diamonds and arrow-shaped crystals out of the mass. Some very dark crystals were also noticed. All the original sample of nitrosyl-bearing oxide had been used in getting this far, and in order to obtain more of the nitrosyl salts for complete analysis a further sample of the same oxide was taken, which by that time had been crushed and laid out as necessitated in the practical management of the works.

The new samples, however—and several representative ones were taken—showed no detectable nitrosyl content. It was evident that crushing in the oxide breaker and subsequent aeration of the oxide broke down the nitrosyl compounds by oxidation. Sufficient data for the elucidation of the exact constitution of the salts therefore was not available, but certain definite conclusions may be drawn.

The dark crystals noted in the chloroform-acid extract have the solubility properties of hydrogen ferroheptanitrosyl sulphide, and the solution they were in evolved nitrogen dioxide and/or nitric oxide on oxidation. Any Roussin salts originally present in the oxide would be converted into the hydrogen salt in the process of acid extraction. The probability of the presence of Roussin salts is thus indicated, but the possibility of other nitrosyl compounds must not be excluded. Worthy of mention among other compounds are alkali ammonium nitroferricyanide, ferrous dinitrosyl sulphide,



and organo-metallic complexes, as, for example, pyridine ferroheptanitrosyl trisulphide,

$$C_5H_5N.\ H(Fe_4(NO)_7S_3)$$

The original aqueous extract was obviously a very dilute solution of some dark-coloured substance; this fits in well with the colouring property of Roussin's black salt. The fact that no reaction was given with the Griess reagent on oxidation must not be taken as precluding the presence of minute quantities of the black salt in the oxide because of its low solubility referred to above, for quantities might have been present which were sufficient to colour the water but insufficient to give amounts of nitrogen dioxide or nitric oxide detectable in the method employed. It must be borne in mind that any nitrosyl compounds will only be present in traces, for gas containing one part per million of nitric oxide causes considerable gum formation, and coal gas during normal working contains even less.

This, coupled with the fact that external revivification destroys the nitrosyl compounds as previously mentioned might account for the inability to find any Roussin salts in other samples of spent oxide both at Dudley and by other workers at different works(8).

Summary

1. Some nitrogenous gum particles are sufficiently small to pass through filters which normally arrest the majority of gum particles, and passing through to the burner tip are there decomposed into a carbonaceous deposit. Such gum particles can be arrested to a large extent by extra filters and impingers.

2. Gum particles carried into a bunsen flame can be decom-

posed into a carbonaceous substance and deposited on a relatively cool article held in that flame.

3. The admission of nitric oxide into oxide purifiers causes the formation of nitrosyl compounds which can be broken down under high temperature conditions (over 90°F.) and in the presence of oxygen, liberating nitric oxide. This re-formation of nitric oxide appears essentially to be an oxidation process, for heat (up to 100°C.) alone causes no evolution of NO or NO_2. Schuftan's observation of the decomposition of Roussin salts referred to above agrees well with these results too.

4. Nitric oxide once admitted to a purifier box is liable to be evolved again, even after lengthy periods, as long as that box is in commission.

5. Crushing and external revivification of the oxide destroy the nitrosyl compounds.

The Author is indebted to the Engineer and Directors of the Dudley, Brierley Hill, and District Gas Company for permission to publish these results.

References.

1. W. H. Fulweiler.—*Gas J.*, **200**, 570 (1932). *Ibid.*, **206**, 207 (1934). A. L. Ward, C. W. Jordan, and W. H. Fulweiler.—*Ind. Eng. Chem.*, **24**, 969 (1932). *Ibid.*, **27**, 1180 (1935).
2. P. Schuftan.—*Von den Kohlen und den Mineralölen*, Part VI. "Über schwere Kohlenwasserstoffe und andere Bestandteile des Koksofengases," *Trans. Inst. Gas E.*, **86**, 568 (1936–37). *Gas J.*, **216**, 466 (1936).
3. Sir G. T. Morgan.—*Trans. Inst. Gas E.*, **86**, 562 (1936–37). *Gas J.*, **216**, 464 (1936).
4. H. A. J. Pieters.—*Brennstoff-Chem.*, **21**, 285 (1931). G. Berkhoff.—*Het. Gas.*, **51**, 460 (1931); **52**, 119 (1932).
5. H. Hollings.—*Trans. Inst. Gas E.*, **86**, 501 (1936–37). *Gas J.*, **216**, 459 (1936).
6. Z. Roussin.—*Ann. Chim. Phys.*, **52**, 285 (1858). *Bull. Soc. Chim.*, **1**, 210 1864). *Compt. Rend.*, **46**, 224 (1858). *Liebig's Ann.*, **107**, 120 (1858).
I. Bellucci and P. de Cesaris.—*Atti Accad. Lincei*, **16**, ii, 740 (1907).
I. Bellucci and D. Venditori.—*Ibid.*, **14**, i, 28, 98 (1905).
I. Bellucci and F. Carnevali.—*Ibid.*, **16**, i, 654 (1907).
W. Manchot and E. Linckh.—*Ber.*, **59**, B, 406, 412 (1926).
W. Manchot.—*Zeit. angew. Chem.*, **24**, 13 (1911). *Ber.*, **47**, 1601 (1914).
Idem and F. Huttner.—*Liebig's Ann.*, **372**, 153 (1910).
A. Werner.—*Ber.*, **45**, 433 (1912).
K. A. Hoffmann and O. F. Wiede.—*Zeit. anorg. Cheme.*, **11**, 228 (1896).
C. Marie and R. Marquis.—*Compt. Rend.*, **122**, 137 (1896).
7. F. Feigl.—*Qualitative Analyse mit Hilfe von Tüpfelreaktionen*, English edition, p. 203.
8. K. Bunte, H. Bruckner, and G. R. Haas.—*Gas u. Wasserfach.*, **78**, 754 (1935).

NEW PATENT

Electrical Precipitation

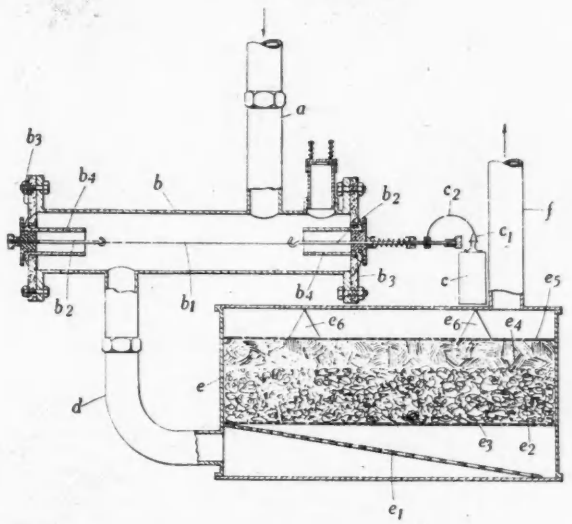
The Gas Light and Coke Company, E. H. M. Badger and James Burns have been granted a patent (No. 536,429; application date, Nov. 24, 1939) for improvements in the electrostatic removal of suspended particles from gases. The primary object of the invention is to produce an apparatus particularly adapted for removing the dust from the gas formed in producer plants on motor vehicles.

According to the invention, in such a plant provided with a charging chamber through which the gas is first passed, and a depositing chamber to which the gas is subsequently conducted, and so arranged that the gas remains in the charging chamber for a period not long enough for many of the suspended particles to be deposited on the charging electrode but long enough for them to receive the greater part of the maximum electrical charge which the apparatus is capable of imparting to them, the gas is led to the under surface of a permeable mass of material in the depositing chamber, so that suspended particles are largely deposited on that under surface and can readily be caused to fall away from it. Actually on a motor vehicle, such apparatus is naturally subjected to considerable vibration so that the deposited particles can be shaken off when the vehicle is driven and collected in a receptacle below the permeable mass of material, and can be removed from time to time. The result of this is that during the operation of the apparatus, the filtering mass does not become clogged with deposited particles so that the rise in back pressure while the apparatus is in use is small. It is found that good results are obtained by using a mass of material consisting of loosely packed steel wool which being conductive also immediately discharges the particles of dust on impact.

The charging chamber may be a tubular chamber with a central electrode, for example, a wire charged to a high electrical potential. In order to set up the corona discharge necessary, it is possible to use voltages of different values and, in fact, the thinner the wire of the charging electrode, the lower the voltage which may be employed so that it is possible to work with an ordinary spark coil instead of an installation which includes a substantial high-tension transformer. Such an apparatus used with a gas producer on a motor vehicle can be used continuously for a considerable time and the collected dust removed from the receptacle at convenient intervals. The cleansed gas leaving the apparatus can be passed on to the vehicle engine.

One form of the invention applied to the removal of dust from the gas formed in producer plants for motor vehicles is described with reference to the accompanying drawing, which is a sectional elevation of the precipitating apparatus.

Gas from the producer is passed through a combined cooler and settling chamber of normal construction, which results in the removal of the larger particles of dust. Dust particles above a size of 5 microns may be removed in this way if an efficient settling chamber is employed. The gas with the smaller particles of dust is then led in through the inlet pipe *a* to a tubular charging chamber *b*. This contains a central electrode in the form of a wire b_1. This electrode is insulated from the metal body of the charging member *b* by the fact that it is supported between hooks b_2 which are mounted in the end covers, b_3, which are rings of fibre or other insulating material, and also the hooks b_2 are largely surrounded by re-entrant porcelain tubes b_4. The wire b_1 is charged with an electrical potential sufficient to produce a corona discharge by means of a spark coil *c*. Its earthed terminal is connected to the metal framework of the vehicle, and thence to the metal body of the chamber *b*, while its high tension terminal c_1 is connected by a conductor c_2 to the wire b_1. A coil, sufficient to give a potential of from 10,000 to 30,000 volts, may be used. The primary circuit of the coil supplied by a battery may be interrupted at contacts which are opened by the form of electromagnetically actuated vibrator commonly used with spark coils or a rotary contact breaker driven by a small electric motor may be provided. The primary winding of the coil may, however, be interrupted by the rotary contact breaker used for the vehicle engine, but, in that case, the collection of moisture in the



precipitator may interfere with the insulation of the engine ignition system, and may weaken the ignition spark, although then, of course, a separate contact breaker to the precipitator is not required.

The dimensions of the chamber *b* may be such that the gas, at its maximum rate of flow, takes approximately one-tenth of a second to pass through it. During this time, particles in the gas acquire about 90% of the electrical charge which the apparatus is capable of imparting to them, and not more than about 10% of the particles are deposited on the wall of the tubular chamber *b*.

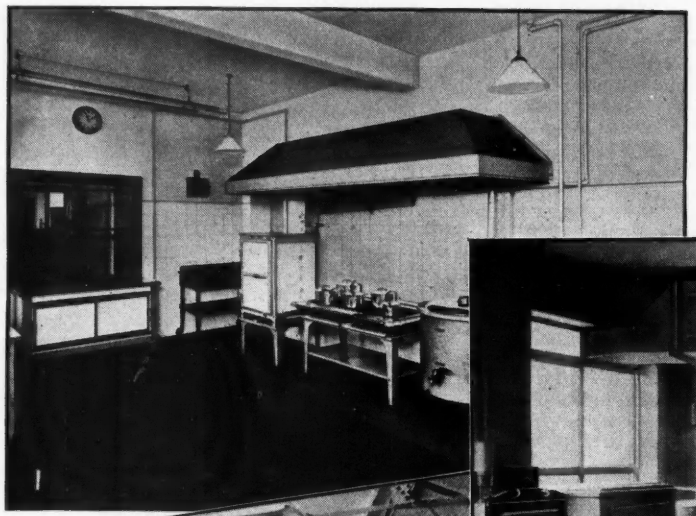
The gas leaves the chamber *b* through the pipe *d* and then enters a filter box *e*. In this box, after passing an inclined baffle plate e_1, it impinges against a layer of loosely packed steel wool e_2 supported on a grid e_3. In order that the flow of gas may be approximately uniform over the whole cross-section of the box *e*, the apertures in the baffle plate e_1 are graduated, as shown, increasing in size the further they are from the inlet from the pipe *d*. The charged particles are robbed of their charges upon impact with the steel wool e_2, and as they are discharged, they are precipitated and fall to the bottom of the box owing to the vibration on the vehicle from which they may be removed at the necessary intervals.

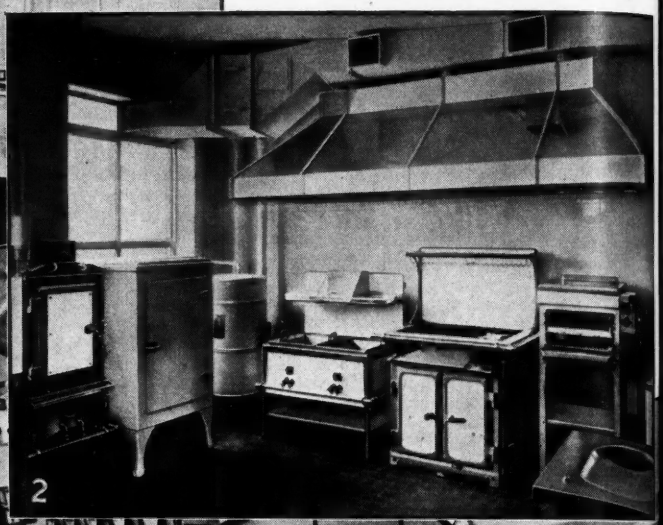
In order to retain any particles which may pass through the steel wool e_2, a layer of sisal tow e_4 is placed above the steel wool e_2, although other suitable filtering material may be employed instead. This tow is retained in place by an upper grid e_5 kept in position by spacers or distance pieces e_6. The cleaned gas then passes through the outlet pipe *f* to the engine.

Various modifications may, of course, be made. For example, the coil *c* may be replaced by an alternating current generator driven from the engine shaft and supplying a step-up transformer which may provide the necessary high voltage for charging the electrode b_1.

The invention is of particular advantage in connexion with producer gas plants for motor vehicles since the gas is sufficiently freed from suspended particles without any considerable loss of power due to high resistance to flow which is generally encountered when an efficient filter is employed, which gradually becomes choked with the removed particles. Furthermore, the weight and size of a filter which would be effective to free the gas from suspended particles, are much greater than those of a charging precipitating device as described above.

Large





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2. Canteen Kitchen of Spratt's Patent Ltd. Radia... Equipment installed by the Commercial ... Company.
3. A County Mental Hospital. Radiation appara... installed by The Brightside Foundry & Engine... Co. who also made and installed a number of st... heated appliances.
4. An Industrial Canteen. Kitchen planned by ... local Gas Dept.
5. Another County school for Girls—Photograph... courtesy of the Surrey County Council.

Gas Products Prices

The London Market

Aug. 4.

There are no alterations in the prices of Tar products in the London market. They remain approximately as follows:

Pitch is nominal; creosote 4¾d. to 5d.; refined tar 3¾d. to 4d.; pure toluene under the Ministry of Supply Toluene No. 2 Order 2s. 5d.; pure benzole 1s. 10d.; 95/160 solvent naphtha 2s. 5d. to 2s. 8d., and 90/160 pyridine 13s. 6d.; all per gallon naked; refined crystal naphthalene £23 per ton in bags; all *ex* Makers' Works.

The Provinces

Aug. 4.

The average prices of gas-works products during the week were: Pitch and Crude Tar,* Toluole, naked, North, 1s. 10d. (controlled by the Control of Toluene No. 2 Order, July 5, which fixes the maximum price at which this material may be sold). Coal tar, crude naphtha, in bulk, North, 10d. to 11d. Solvent naphtha, naked, North, 1s. 9d. to 1s. 10d. Heavy naphtha North, 1s. 6d. to 1s. 7½d. Creosote, *ex* works, in bulk, North, liquid and salty, 4½d. to 4¾d.; Scotland, 4¼d. to 4¾d.; low gravity, 4¼d. to 4¾d. Fuel Grade, 4d. to 4¼d. Carbolic acid, 60's, 3s. 7½d. to 3s. 9d. Naphthalene, £12 to £15. Salts, 70s. to 80s., bags included. Anthracene, "A" quality, 4½d. to 4¾d. per minimum 40% purely nominal. Heavy oil: Unfiltered anthracene oil (min. gr. 1,080), 5¼d. to 5½d.; filtered heavy oil (min. gr. 1,080), 5¾d. to 6d.; heavy anthracene oil gr. less than 1,080, 6d. to 6¼d.

*In regard to pitch and crude tar prices we would ask readers to refer to the editorial note in our issue of Sept. 4, 1940, p. 404.

Tar Products in Scotland

GLASGOW, Aug. 2.

No material alterations can be recorded in this district. Prices are well held with deliveries proceeding smoothly.

Refined tar continues quite active at 4¾d. to 5d. per gallon for delivery in the home market and round 3½d. per gallon for export, both f.o.r. naked.

Creosote oil remains steady at the following prices: Specification oil, 5¾d. to 6d. per gallon; low gravity, 6½d. to 7d. per gallon; neutral oil, 6d. to 6½d. per gallon; all *ex* Works in bulk.

Cresylic acid is not too plentiful locally with values nominal as under: Pale, 99/100%, 3s. 4d. to 3s. 6d. per gallon; Pale, 97/99%, 3s. to 3s. 2d. per gallon; Dark, 97/99%, 2s. 8d. to 2s. 10d. per gallon. All *ex* Works in buyers' packages.

Crude naphtha is called round 6½d. to 7½d per gallon *ex* Works in bulk, according to quality.

Solvent naphtha: 90/160 grade is 1s. 8½d. to 1s. 9d. per gallon and 90/190 Heavy Naphtha is 1s. 4½d. to 1s. 5½d. per gallon.

Pyridines are nominal at about 14s. per gallon for 90/160 grade and 16s. per gallon for 90/140 grade.

London and Southern District Junior Gas Association

An extremely well-attended meeting of the above Association was held at the Westminster Technical Institute on July 25, the President, Mr. F. O. Hawes, being in the Chair. The meeting took the form of a discussion on "Experiences in the dealing with the effects of enemy action on the works and district."

Among those taking part in the discussion were Mr. Michael Milne-Watson, of the London Regional Gas Centre, Mr. H. J. Escreet, Gas Light and Coke Company, Mr. McLeod, South Metropolitan Gas Company, Mr. Dougill, Gas Light and Coke Company, Mr. Moys, Commercial Gas Company, and Mr. Grayston, Romford Gas Company.

The information given by speakers proved most interesting and should be of great value to those present who had not had first-hand experience of difficulties due to air-raid damage.

The next meeting of the Association will be on Friday, August 29, at the Westminster Technical Institute, when Mr. P. Turnbull, Gas Light and Coke Co., will read a Paper on "Some of the applications of electricity in the Gas Industry."

East Surrey Gas Stock

At a meeting of the Board of the East Surrey Gas Company held last Wednesday the undermentioned dividends were declared for the half-year ended June 30, 1941, all less income-tax at 10s. in the £:

On Cumulative Preference Stock, 3% actual (£3 per £100 stock).
„ Redeemable Preference Stock, 2½% actual (£2 5s. per £100 stock).
„ Preference "A" Stock, 2¾% actual (£2 15s. per £100 stock), and
„ Ordinary "B" Stock, 2½% actual (£2 10s. per £100 Stock).

A Meeting of the Central Executive Board of the National Gas Council will be held in Committee Room No. 1, Gas Industry House, on Tuesday, Aug. 12.

The Next Meeting of the Central Executive Board of the National Gas Council has been fixed for Tuesday, Sept. 9, at Gas Industry House.

Southport Gas Committee has received sanction to borrow £5,000 for the purchase of gas cookers.

A.R.P.

PROTECTION OF SANDBAGS.

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GAS STOCKS AND SHARES

More encouraging news gave a fillip to Stock Exchange business last week and prices showed a general, if moderate rise in many sections. British Funds were rather overshadowed by the demand elsewhere and, while the majority closed unchanged on the week, there were a few fractional falls including 2½% Consols with a drop of ¼ to 81¾. Home rails on the other hand were a strong feature, particularly on rumours of some changes in the existing agreement with the Government, and the junior stocks made substantial progress. There was a broadening of interest among industrials, and although profit-taking caused some of the leaders to close below the best, a large number of shares appreciated in value. Oil shares were firm and more active and renewed Cape support assisted the Kaffir market. Rubber and tea shares were dull without much change in prices.

There was no lessening in the recent renewal of demand for Gas stocks and shares, and an appreciable volume of business was recorded. It is satisfactory to note that over the past few weeks between forty and fifty of the issues shown in the list below have improved in value, and included among these were several ordinary and preference stocks on which no dividends were paid for the last half of 1940. This is a healthy sign and indicates that the ordinary investor has faith in the future of the Industry, despite its present troubles. And well he may, for there can be no doubt that "gas," in conjunction with other means of fuel and light, will play an important part in the reconstruction after the war.

Quotations on the London and Provincial Stock Exchanges

OFFICIAL LIST

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations July 31.	Rise or Fall on week.
1,767,439	March 10	7	6	Alliance & Dublin Ord. ...	85—90	...
374,000	June 30	4	4	Do. 4 p.c. Deb. ...	90—95	...
957,608	May 5	5	5	Assed. Gas & Water U'd'ts Ord.	12/9—13/9	...
500,000	,,	4½	4½	Do. 4½ p.c. Red. Cum. Pref.	14/—16/—	...
535,545	,,	4	4	Do. 4 p.c. Red. Cum. Pref.	14/—16/—	...
336,646	,,	4	4	Do. 4 p.c. Irred. Cum. Pref.	9/6—11/6	...
561,370	Feb. 17	7	7	Barnet Ord. 7 p.c.	112—117	+5
300,000	June 3	1/4⅛	1/9⅜	Bombay, Ltd.	19/—21/—	...
690,407	Feb. 24	7	7	Bournemouth 7 p.c. max. ...	112—117	+2½
362,025	June 16	4	4	Do. 4 p.c. Deb. ...	90—95	+2
659,955	March 3	4⅜	2½	Brighton, &c., 5 p.c. Con. ...	60—65	...
855,000	March 10	6	6	Brit. Gas Light Ord.	65—75	...
545,000	June 16	5½	5½	Do. 5½ p.c. 'B' Cum. Pref	105—115	...
120,000	,,	4	4	Do. 4 p.c. Red. Deb.	75—80	...
10,000	Nov. 6 '33	6	4	Cape Town, Ltd., 4½ p.c. Cu. Pf.	¼—¾	...
626,860	July 21	6	6	Cardiff Con. Ord.	86—91	...
24,500	May 5	7	7	Colombo 7 p.c. Pref.	18/6—19/6	...
764,169	March 24	-/11.48	-/11.48	Colonial Gas Assn. Ltd. Ord. ...	14/—16/—	...
400,000	,,	1/3.30	1/3.30	Do. 8 p.c. Pref. ...	19/—21/—	...
1,748,935	July 22 '40	2	3	Commercial Ord.	27—32	...
620,000	June 9	3	3	Do. 3 p.c. Deb.	55—60	...
286,344	Feb. 7	5	5	Do. 5 p.c. Deb.	87—92	...
807,560	Feb. 24	6	6	Croydon sliding scale	80—85	...
644,590	,,	5	5	Do. max. div.	80—85	+5
620,385	Dec. 30	5	5	Do. 5 p.c. Perp. Deb. ...	95—100	...
179,500	Feb. 10	5	5	East Surrey 'B,' 5 p.c.	65—70	+2½
176,461	June 16	5	5	Do. 5 p.c. Deb. (Irred.)...	90—95	...
250,000	July 14	4	6	Gas Consolidation Ord. 'B' ...	13/6—14/6	...
250,000	May 12	4	4	Do. 4 p.c. Red. Cum. Pref.	14/6—16/6	...
19,122,910	July 29 '40	3⅜	4½	Gas Light & Coke Ord. ...	12/9—13/9a	...
2,600,000	,,	3½	3½	Do. 3½ p.c. max.	40—45	+1
4,477,106	,,	4	4	Do. 4 p.c. Con. Pref. ...	60—65	+2
2,993,000	July 8 '40	3¾	3¾	Do. - 3¾ p.c. Red. Pref. ...	62—67	...
8,602,497	June 3	3	3	Do. 3 p.c. Con. Deb. ...	72—77	...
3,642,770	,,	5	5	Do. 5 p.c. Red. Deb. ...	102—107	...
3,500,000	,,	4½	4½	Do. 4½ p.c. Red. Deb. ...	100—105	...
700,000	March 10	3½	3½	Do. 3½ Red. Deb. ...	80—85	...
9,600,000	May 13 '40	4	8	Imperial Continental Cap. ...	52—57	+1
43,820	July 28	3½	3½	Do. 3½ p.c. Red. Deb. ...	75—80*	...
231,978	Feb. 24	5	5	M.S. Utility 'C' Cons.	67—72	...
918,657	,,	4	4	4 p.c. Cons. Pref.	73—78	...
675,000	May 5	†4	†4	Montevideo, Ltd.	53—58	...
300,000	April 28	9	7	Oriental, Ltd.	119—124	...
368,537	Dec. 9	8	6½	Plymouth & Stonehouse 5 p.c.	65—70	...
621,667	Feb. 3	7½	7½	Portsmouth & Gosport Cons.	88—93	...
648,999	May 12	1/1	1/1⅛	Severn Val. Gas Cor. Ld. Ord.	14/—16/—	...
597,972	March 10	-/10⅜	-/10⅜	Do. 4½ p.c. Cum. Pref. ...	16/—18/—	...
2,528,714	May 19	7⅛	1/-	South East'n Gas Cn. Ld. Ord.	10/—12/—	...
1,000,000	March 3	-/10⅜	-/10⅜	Do. 4½ p.c. Red. Cum. Pref.	14/—16/—	+-/6
1,068,869	,,	4	4	Do. 4 p.c. Irred. Cum. Pref.	11/6—13/6	...
6,709,895	Aug. 5 '40	4	4	South Met. Ord.	48½—53	...
1,135,812	,,	6	6	Do. 6 p.c. Irred. Pref. ...	72—77	...
850,000	,,	4	4	Do. 4 p.c. Irred. Pref. ...	55—60	...
1,895,445	July 14	3	3	Do. 3 p.c. Perp. Deb. ...	68—73	+1
1,000,000	Jan. 15	5	5	Do. 5 p.c. Red. Deb. ...	99—104	...
1,543,795	Feb. 24	4	2	South Suburban Ord. 5 p.c. ...	58—63	...
512,825	,,	5	5	Do. 5 p.c. Perp. Pref. ...	72—77	+2
500,000	,,	4	4	Do. 4 p.c. Perp. Pref. ...	63—68	...
250,000	,,	3¾	3¾	Do. 3¾ p.c. Red. Pref. ...	79—84	...
888,587	June 16	5	5	Do. 5 p.c. Perp. Deb. ...	95—100	...
750,541	Feb. 10	5	2	Southampton Ord.	50—55	...
350,000	Feb. 10	5½	5½	Swansea 5½ p.c. Red. Pref. ...	88—93	...
1,076,495	Feb. 24	5	5	Tottenham & District Ord. ...	70—75	...
338,555	,,	5	5	Do. 5 p.c. Pref.	78—83	...
453,380	June 9	4	4	Do. 4 p.c. Perp. Deb. ...	79—84	...
1,247,505	May 20 '40	4	6	U. Kingdom Gas Cor. Ord. ...	10/6—12/6	...
1,085,952	May 19	4½	4½	Do. 4½ p.c. 1st Cum. Pref. ...	13/6—15/6	...
772,709	,,	4	4	Do. 4 p.c. 1st Red. Cum.Pref.	13/—15/—	...
745,263	June 16	4½	4½	Do. 4½ p.c. 2nd Non.Cum. Pf.	9/6—11/6	...
1,200,000	March 17	3½	3½	Do. 3½ p.c. Red. Deb. ...	84—89	...
380,606	Abril 15	7	6½	Uxbridge, &c., 5 p.c.	80—90	...
1,371,138	April 7	4	4	Wandsworth Consolidated ...	64—69	...
2,525,768	,,	4	4	Do. 4 p.c. Pref.	63—68	...
1,843,964	June 16	5	5	Do. 5 p.c. Deb.	97—102	...
283,745	,,	4	4	Do. 4 p.c. Deb.	75—80	...
358,342	Feb. 24	5	5	Watford & St. Albans Ord. ...	85—90	...
300,000	June 9	3½	3½	Do. 3½ p.c. Red. Deb. ...	84—89	...

SUPPLEMENTARY LIST

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations July 31.	Rise or Fall on week
351,685	June 16	5	5	Brighton, &c., 5 p.c. Perp. Deb.	88—93	...
28,700	,,	5½	5½	Do. 5½ p.c. Red. Deb. 1942 ...	95—100	...
415,250	,,	4	4	Bristol Gas Co., 4 p.c. New Deb.	87—92	...
140,205	Feb. 3	7	7	Cambridge, &c., 7 p.c. Cons. 'B'	100—110	...
295,932	March 3	5	5	Cheltenham, 5 p.c. Cons.Ord....	85—90	...
42,500	June 16	4	4	Do. 4 p.c. Perp. Deb....	75—80	...
150,000	Feb. 24	4	4	Croydon Gas, 4 p.c. Pref. (Irr.)	68—73	...
130,000	Dec. 30	4	4	Do. 4 p.c. Deb. ...	75—80	...
146,700	Feb. 10	5½	5½	East Surrey, 5½ p.c. Pref. 'A' ...	80—90	...
53,220	,,	10	6	Do. 6 p.c. Cum. Pref. ...	90—100	...
...	Aug. 19	6	4	Eastbourne, 'B' 3½ p.c.... ...	30—50	...
239,135	July 14	5	5	Gas Consolidation 'A' Ord. (£1)	11/6—13/6	...
156,600	Feb. 24	5	5	Hampton C't, 5 p.c. Cons. Ord.	67—72	...
18,000	June 30	3½	5½	Malta & Med'n., 7 p.c. 1st Pref.	50—60	...
10,845	,, 2	3½	3½	Do. 7½ p.c. 2nd Pref.	40—50	...
50,000	Feb. 24	£5 19 6	£5 4 6	Mid. South. Util., 'A' Cons. 5 p.c.	60—70	...
65,000	April 21	5	5	North Middlesex, 5 p.c. Pref....	75—80	...
70,000	March 10	5	5	Plymouth & Stone., 5 p.c. Deb.	83—88	...
76,501	June 30	4	4	Reading, 4 p.c. Perp. Deb. ...	70—75	...
74,777	March 31	4	4	Romford, 4 p.c. Debs. (Reg.) ...	77—82	...
21,000	June 9	5	5	Slough, 5 p.c. Perp. Deb. ...	87—92	...
211,740	,, 16	5	5	Southampton, 5 p.c. Red. Deb.	95—100	...
363,575	July 1	5	5	Tottenham, 5 p.c. Reg. Red. Mt.	96—101	...
202,019	April 15	6¾	6¾	Tunbridge Wells, 4 p.c. Scale ...	70—80	...
135,257	June 9	5	5	Uxbridge &c., 5 p.c. Perp. Deb.	95—100	...

PROVINCIAL EXCHANGES

					Quotations July 25.	
804,948	March 10	5	5	Bath Cons.	94—98	...
122,577	March 10	7	6	Blyth 5 p.c. Ord.	100—105	...
1,667,250	July 22	5	5	Bristol, 5 p.c. max.	83—85	...
120,420	June 16	4	4	Do. 1st 4 p.c. Deb.	94—96	...
415,250	,,	4	4	Do. 2nd 4 p.c. Deb. ...	91—94	...
328,790	,,	5	5	Do. 5 p.c. Deb.	110½—113½	...
157,150	Feb. 3	5	6½	Chester 5 p.c. Ord.	78—80	...
92,500	June 16	4	4	Do. 4 p.c. Pref.	78—80	...
36,430	,,	3½	3½	Do. 3½ p.c. Deb.	78—80	...
41,890	,,	4	4	Do. 4 p.c. Red. Deb. ...	92—95	...
542,270	Feb. 10	6	9	Derby Cons.	98—103	...
55,000	Dec. 16	4	4	Do. 4 p.c. Deb.	75—80	...
10,000	March 3	10	10	Great Grimsby 'A' Ord. ...	155—165	...
6,500	,,	10	10	Do. 'B' Ord.	155—165	...
79,000	,,	10	10	Do. 'C' Ord.	145—155	...
732,000	Feb. 24	4	4	Hartlepool G. & W. Cn. & New	61—63	...
2,167,410	Feb. 17	6	6	Liverpool 5 p.c. Ord.	91—94	...
245,500	June 16	5	5	Do. 5 p.c. Red. Pref. ...	96½—99½	...
306,083	July 15	4	4	Do. 4 p.c. Deb.	94—99	...
20,000	Dec. 23	5	5	Long Eaton 5 p.c. Pref.	9—11	...
80,000	,,	5	5	Do. 5 p.c. Deb.	87—92	...
2,430,267	Feb. 10	5	5½	Newcastle and Gateshead Con.	17/6—18/6a	...
682,856	,,	4	4	Do. 4 p.c. Pref.	82—83	...
776,706	Dec. 23	3½	3½	Do. 3½ p.c. Deb.	82—84	...
277,285	Oct. 21	5	5	Do. 5 p.c. Deb. '43 ...	97—102	...
274,000	March 17	5	5	Newport (Mon.) Ord.	86—89	...
13,200	Sept. 16	8½	7	Pontyp'l Gas & W. 10 p.c. 'A'	11½—12½	...
13,600	,,	6	5	Do. 7 p.c. 'B'	9½—10½	...
40,000	,,	5	6	Do. 7 p.c. 'C'	9½—10½	...
106,280	Feb. 3	10	10	Preston 'A' 10 p.c.	157—167	...
188,219	,,	7	7	Do. 'B' 7 p.c.	113—123	...
1,806,339	Feb. 24	6½	6½	Sheffield Cons.	107—109	...
95,000	July 7	4	4	Do. 4 p.c. Deb.	94—97	...
332,351	Feb. 3	6	6	Sunderland 6 p.c. max. ...	107—110	...
192,150	Feb. 12	5	5	Weston-super-Mare Cons. ...	79—84	...
64,338	June 30	4	4	Do. 4 p.c. Deb.	80—85	...
33,340	,,	7½	7½	Do. 7½ p.c. Deb.	135—140	...

a—The quotation is per £1 of Stock. * Ex. div. † Price free of income-tax.

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